

Art Unit: ***

Claims PTO

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AMW

Claims 1-27 cancelled.

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An apparatus for recording environmental data measurements, comprising:

a sensor for detecting environmental data;

a controller for controlling the operation of the sensor, the operation of the sensor including a plurality of operation modes automatically selected by the controller.

29/

The apparatus of claim 1, wherein the controller further comprises:

a front-end circuit coupled to the sensor;

a loop filter coupled to the front-end circuit;

a multiphase clock generator coupled to the front end circuit and the loop filter;

a startup sequencer coupled to the loop filter and the multiphase clock generator;

a sensor simulator for simulating the performance of the sensor coupled to the startup sequencer, the multiphase clock generator, and the front-end circuit; and

an overload detection device coupled to the loop filter and the startup sequencer.

30/

The apparatus of claim 1, wherein the controller comprises:

a front-end circuit for providing electrostatic forces and position sensing for a measurement mass in the sensor, the front-end circuit including:

a plurality of switches for controlling the operation of the sensor; and

Art Unit: ***

31/4. ²⁸ The apparatus of claim 1, wherein the controller further comprises:
a loop filter for providing control to the sensor apparatus, to the loop filter including:
one or more integrators for providing a signal for controlling the sensor system;
one or more derivative controllers for providing a signal for controlling the sensor system;
one or more proportional controllers for providing a signal for controlling the sensor system; and
a summer for combining the signals from the integrators, the derivative controllers, and the proportional controllers.

32/5. ²⁶ The apparatus of claim 1 further comprising:
a multiphase clock generator for providing clock signals for controlling the operation of the apparatus, the clock generator including:
a digital signal generator; and
a data-independent clock resynchronization circuit coupled to the digital signal generator for resampling clock signals.

33/6. ²⁸ The apparatus of claim 1 further comprising:
a sensor simulator for simulating the operation of a sensor, the simulator including:
a filter adapted to receive one or more input signals and generate an output signal representative of the operating state of the sensor; and
an input signal selector operably coupled to the filter adapted to controllably select the input signals as a function of the simulated operating state of the sensor.

34/7. ²⁸ The apparatus of claim 1 further comprising:
a device for testing the operation of the controller, the device comprising:
a sensor simulator for simulating the operation of a sensor; and
a second controller coupled to the simulator.

35/8. ²⁸ The apparatus of claim 1, wherein the controller further comprises:
a feedback control system for providing control to the apparatus, the feedback control system comprising:
a startup sequencer for selecting the mode of operation of the feedback control system;
and
a loop filter coupled to the startup sequencer.

Art Unit: ***

36³² The apparatus of claim 32, wherein the clock resynchronization circuit comprises:
a plurality of inverters;
a plurality of NOR gates coupled to the inverters;
a plurality of NAND gates coupled to the inverters;
a plurality of XNOR gates coupled to the NAND gates and the inverters;
a plurality of asynchronous set double-edge flip-flops coupled to the NOR gates; and
a plurality of asynchronous reset double-edge flip-flops coupled to the NOR gates.

37³⁷ 10. A method of controlling the operation of a sensor assembly, comprising:
using a controller to apply electrostatic forces to a sensor to create one or more sensor operating states; and
sequentially arranging the operating states into which the sensor is placed to create a plurality of operating modes for the sensor assembly.

38³⁷ 11. The method of claim 10 further comprising:
determining an operating mode of the sensor assembly;
adjusting a mode of operation of a loop filter in the sensor assembly;
providing feedback loop compensation to the sensor assembly during a start-up mode of operation for the sensor assembly; and
providing noise shaping to the sensor assembly during a sigma-delta mode of operation for the sensor assembly.

39³⁷ 12. The method of claim 10, wherein the sensor assembly includes a loop filter, one or more integrators, a proportional controller, the method further comprising:
placing a loop filter including one or more integrators, a proportional controller, and a derivative controller in a reduced-order operating mode;
sending a signal to the loop filter to control the operating mode of the loop filter; and
holding the integrators within the loop filter in a reset mode to place the loop filter in the reduced-order operating mode.

40³⁹ 13. The method of claim 12 further comprising:
taking the integrators out of the reset mode to place the loop filter in a normal operating mode when the sensor system is operating in a sigma-delta operating mode.

Art Unit: ***

41/14. The method of claim 39, wherein the operating mode of the loop filter further comprises:
sending a signal to the loop filter indicating an operating mode of the sensor assembly;
operating the loop filter in a reduced-order mode while the sensor assembly is operating
in a start-up mode;

operating the loop filter in the reduced-order mode for a predetermined period of time
after the sensor assembly transitions from the start-up operating mode to a sigma-delta
operating mode; and

operating the loop filter in a normal mode during the sigma-delta operating mode after
the predetermined period of time during which the loop filter operates in reduced-order mode.

42/16. The method of claim 41, wherein the operating mode of the loop filter further comprises:
operating the loop filter in a reduced-order mode while the sensor assembly is operating
in the sigma-delta operating mode.

43/16. The method of claim 37 further comprising:
generating a clock signal for the sensor assembly, the generating including:
generating a first clock signal; and
resampling the first clock signal to generate a second clock signal to restore signal
integrity and providing a timing relationship.

44/17. The method of claim 37 further comprising:
resampling an input signal to the sensor assembly, the resampling including:
resampling the input signal in a first level-sensitive latch, including one or more
transmission gates, one or more NOR gates, and one or more inverters, on one edge of a clock
input signal; and
resampling the input signal in a second level-sensitive latch, including one or more
transmission gates, one or more NOR gates, and one or more inverters, acting in parallel with
the first level-sensitive latch, on another edge of the clock input signal.

Art Unit: ***

45³⁷
16. The method of claim 10 further comprising:
resampling an input signal to the sensor assembly, the resampling including:
resampling the input signal in a first level-sensitive latch, including one or more transmission gates, one or more NAND gates, and one or more inverters, on one edge of a clock input signal; and
resampling the input signal in a second level-sensitive latch, including one or more transmission gates, one or more NAND gates, and one or more inverters, acting in parallel with the first level-sensitive latch, on another edge of the clock input signal.

46³⁷
17. The method of claim 10, wherein the controller includes an analog control circuit, the method further comprising:
operating the analog control circuit by generating a first clock signal;
resampling the first clock signal to generate a second clock signal to restore signal integrity and provide a proper timing relationship; and
driving the analog control circuit using the second clock signal.

47³⁷
18. The method of claim 10 further comprising testing the controller, wherein the test comprises:
connecting a sensor simulator to the controller;
supplying an input signal of a known value to the sensor simulator;
converting the input data to the sensor simulator into an output stream from the sensor simulator;
sending the output stream from the sensor simulator to the controller;
processing the output stream from the sensor simulator within the controller to create an output stream from the controller; and
analyzing the output from the controller to determine the accuracy of the controller.

48³⁷
19. The method of claim 10 further comprising:
offsetting the effects of external acceleration forces on the sensor assembly independent of sensor assembly orientation by applying electrostatic forces to a sensor element to offset the effects of the acceleration force.